

## Claims:

1. A process for coupling aromatic or heteroaromatic halogen compounds to form one or more C-C single bonds, characterized in that an Ni(0) complex comprising at least two different ligands, with at least one ligand being selected from each of the two groups consisting of heteroatom-containing ligands (group 1) and of  $\pi$  system ligands (group 2), is used in catalytic amounts, and a reducing agent which converts consumed nickel back into Ni(0) is used; the reaction takes place in an anhydrous, aprotic medium under a very largely inert atmosphere, with the proviso that no phosphorus-containing compound is added.
2. The process as claimed in claim 1, characterized in that it occurs in a single phase.
3. The process as claimed in claim 1 and/or 2, characterized in that the aromatic or heteroaromatic halogen compounds are aromatics or heteroaromatics having from 2 to 40 carbon atoms, which can be substituted by one or more linear, branched or cyclic alkyl or alkoxy radicals which have from 1 to 20 carbon atoms and in which one or more nonadjacent CH<sub>2</sub> groups can be replaced by O, C=O or a carboxy group, substituted or unsubstituted C<sub>2</sub>-C<sub>20</sub>-aryl or -heteroaryl radicals, fluorine, cyano, nitro groups or can also be unsubstituted.
4. The process as claimed in claim 3, characterized in that the aromatics or heteroaromatics are substituted or unsubstituted derivatives of benzene, naphthalene, anthracene, pyrene, biphenyl, fluorene, spiro, 9,9'-bifluorene, phenanthrene, perylene, chrysene, naphthacene, pentacene, triptycene, pyridine, furan, thiophene, benzothiadiazole, pyrrole, quinoline, quinoxaline, pyrimidine or pyrazine.
5. The process as claimed in one or more of claims 1 to 4, characterized in that the catalyst is prepared beforehand.
6. The process as claimed in one or more of claims 1 to 4, characterized in that the catalyst is prepared in situ.
7. A process for preparing an Ni(0) complex, characterized in that a reducing agent is mixed with an Ni(II) salt dissolved in DMF at room temperature, a ligand solution in toluene is slowly added and the mixture is stirred vigorously.

8. The process as claimed in one or more of claims 1 to 6, characterized in that the ligands of group 1 contain heteroatoms from main group 5 or 6, with the exception of phosphorus.

9. The process as claimed in claim 8, characterized in that the ligands contain nitrogen and/or oxygen.

10. The process as claimed in claim 8 and/or 9, characterized in that the ligands have two  $\eta^1$  coordinations to the nickel, in each case via the heteroatoms.

11. The process as claimed in one or more of claims 1 to 6 and 8 to 10, characterized in that the ligands of group 2 have at least one  $\eta^2$  coordination via a  $\pi$  system to the nickel.

12. The process as claimed in claim 11, characterized in that these ligands comprise alkyne or alkene groups.

13. The process as claimed in claim 11 and/or 12, characterized in that these ligands have two  $\eta^2$  coordinations to the nickel, in each case via the  $\pi$  systems.

14. The process as claimed in one or more of claims 1 to 6 and 8 to 13, wherein relatively nonpolar solvents such as aliphatic and aromatic hydrocarbons serve as solvent.

15. The process as claimed in claim 14, characterized in that pentane, cyclohexene, toluene or xylene serve as solvent.

16. The process as claimed in claim 14 and/or 15, characterized in that these solvents are mixed with inert, dipolar solvents such as N,N'-dimethylformamide, N,N'-dimethylacetamide, N-methylpyrrolidin-2-one, tetramethylurea, dimethyl sulfoxide or sulfolane.

17. The process as claimed in claim 16, characterized in that a mixture of DMF and toluene is used.

18. A polyarylene which has a phosphorus content of less than 10 ppm and is obtainable by a process as claimed in one or more of claims 1 to 6 and 8 to 17.